

Remarks

Claim 1 is now further defined by inclusion in the preamble of the requirement that the composition being purified is a quaternary ammonium hydroxide contained in a recycle stream obtained from the production of 4-aminodiphenylamine (page 5, first paragraph).

Japanese abstract 03-020489 discloses a method wherein an aqueous solution of quaternary ammonium hydroxide of high purity is supplied to the intermediate compartment. Thus before the solution is supplied to the compartment the solution is first purified by passing it through a column packed with a material forming an inclusion with alkali metal ion such as dibenzo-18-crown-6. The present method requires the use of the aqueous waste as such, without first purifying it and removing the alkali metal ions. Thus the Japanese abstract does not anticipate the present invention, nor does it render it obvious in view of the prior art requirement of purification being the exact opposite of the process of the present invention, in which the quaternary ammonium hydroxide supplied to the intermediate compartment is contained in a recycle stream obtained from the production of 4-aminodiphenylamine, impurities and all.

The above discussion concerning the Japanese abstract applies equally to Moulton (US 6,207,039) in that Moulton gives no hint to treatment of the waste stream of the instant claims. The waste stream of Moulton comprises onium cation and/or non-onium cation and/or onium anion and/or non-onium anion contaminants. Those contaminants are completely different than the contaminants with which the present invention is concerned, which are those found in a recycle stream comprising tetramethylammonium hydroxide obtained from the production of 4-aminodiphenylamine.

Furthermore, it is important to note that, although the processes of the present invention and Moulton (US 6,207,039) perform substantially the same function (purification of quaternary ammonium hydroxides) and achieve substantially the same results (obtaining purified quaternary ammonium hydroxides), they do it in a

substantially different way. The chemistry involved with the use of an ion exchange material, as required by Moulton, is so completely different than the chemistry of the process of the present invention that it renders Moulton irrelevant to the patentability of the process of the present invention. The key difference is how contaminants, which cannot be electrolytically converted back to the quaternary ammonium hydroxides, are handled.

Moulton's process catches onium cation and/or non-onium cation and/or onium anion and/or non-onium anion contaminants by using an ion exchange material in the feed compartment, such that as stated in the patent embodiments in columns 16 - 20, "Impurities remain in the feed compartment and/or migrate to the acid compartment", wherein the acid compartment is the anolyte compartment. An ion exchange material is particularly well suited to the removal of metal ions. The use of the ion exchange material thus allows the quaternary ammonium cation to pass through the membrane to the catholyte compartment free of these impurities.

The process of the present invention protects the anode and anolyte compartment by placing a barrier (membrane) in between the electrolyte (waste aqueous solution) and the anolyte compartment. The barrier does not catch the contaminant (fouling organics, such as aniline and 4-ADPA), but just shields the anode and anolyte compartment. This is in principle different from catching the contaminants by using an ion exchange material and/or allowing them to pass into the anolyte compartment. Moreover, the flux of water and protons prevents the oxidizable organics from diffusing into the membrane (this is also a different mechanism). An ion exchange material would not work in protecting the anode and anolyte compartment from fouling by oxidizable organics, as such compounds are non-ionic.

Furthermore, with regard to instant claim 15 and claims 17-20, it is noted that Moulton's use of back-washing and/or fluidizing does not in fact teach solvent washing of the intermediate compartment for the process of the present invention. Moulton back-washes and/or fluidizes and/or vibrates the electrochemical ion exchange cell to remove

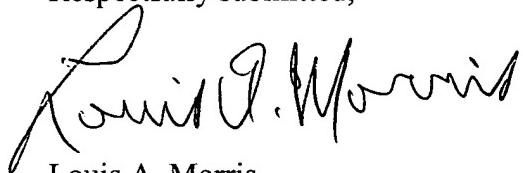
carbon dioxide gas from in and around the ion exchange material. The process of the present invention uses an optional solvent wash to prevent progressive fouling of the membrane between the anolyte and intermediate compartments and the formation of solids in the aqueous solution of the intermediate compartment. These are fundamentally different purposes and mechanisms. Moreover, any teaching of how to clean an ion exchange material has no bearing on the process of the present invention, which does not include an ion exchange material.

The instant claims are neither anticipated nor obvious over Moulton.

Conclusion

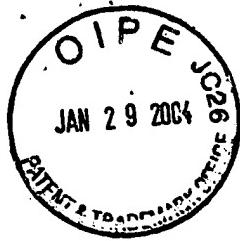
The chemistry involved in the respective processes of the prior art and the present invention are so fundamentally different that the prior art is irrelevant both with regard to anticipation and obviousness considerations. Allowance of the pending claims is respectfully requested.

Respectfully submitted,



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AMENDED CLAIMS

1. (currently amended) A process for improving the purity of a composition comprising a quaternary ammonium hydroxide contained in a recycle stream obtained from the production of 4-aminodiphenylamine comprising the steps of
 - (a) providing an electrolysis cell which comprises an anolyte compartment containing an anode, a catholyte compartment containing a cathode, and at least one intermediate compartment, said at least one intermediate compartment being separated from the anolyte and catholyte compartments by cation selective membranes,
 - (b) charging water, optionally containing a supporting electrolyte, to the anolyte compartment, charging water, optionally containing a quaternary ammonium hydroxide, to the catholyte compartment, and charging the composition comprising the quaternary ammonium hydroxide said recycle stream to be purified to the intermediate compartment,
 - (c) passing a current through the electrolysis cell to produce a purified aqueous quaternary ammonium hydroxide solution in the catholyte compartment, and
 - (d) recovering the purified aqueous quaternary ammonium hydroxide solution from the catholyte compartment.
2. (original) The process of claim 1 wherein the anolyte compartment is charged with an aqueous solution of a strong acid.
3. (original) The process of claim 1 wherein the anolyte compartment is charged with an aqueous 1 to 10 wt% sulfuric acid solution.
4. (original) The process of claim 1 wherein the intermediate compartment is charged with an aqueous solution comprising tetramethylammonium hydroxide (TMAH).

5. (original) The process of claim 1 wherein the intermediate compartment is charged with an aqueous solution containing 5 to 40 wt% of TMAH.
6. (original) The process of claim 1 wherein the intermediate compartment is charged with an aqueous solution comprising TMAH which has been used in the production of 4-aminodiphenylamine for a number of reaction cycles.
7. (original) The process of claim 1 wherein the intermediate compartment is charged with an aqueous solution comprising TMAH which has been used in the production of 4-aminodiphenylamine for a number of reaction cycles and which contains aniline.
8. (original) The process of claim 1 wherein the catholyte compartment is charged with an aqueous solution of a quaternary ammonium hydroxide which is the same as the quaternary ammonium hydroxide present in the composition to be purified.
9. (original) The process of claim 1 wherein the catholyte compartment is charged with an aqueous 5 to 25 wt% TMAH solution.
- 10.(original) The process of claim 1 wherein a three-compartment electrolysis cell is used.
- 11.(original) The process of claim 1 wherein the electrolysis is stopped once a pH of 1 to 7 is reached in the intermediate compartment.
- 12.(original) The process of claim 1 wherein the electrolysis is stopped once a pH of 4 to 7 is reached in the intermediate compartment.

- 13.(original) The process of claim 1 wherein identical cation selective membranes are used.
- 14.(original) The process of claim 1 wherein the cation selective membranes are perfluorinated membranes.
- 15.(original) The process of claim 1 wherein the intermediate compartment is washed with a suitable solvent.
- 16.(original) The process of claim 1 wherein the process is carried out batchwise.
- 17.(original) The process of claim 16 wherein the intermediate compartment is washed with a suitable solvent at the end of the processing of each batch.
- 18.(original) The process of claim 15 wherein the solvent is aniline.
- 19.(original) The process of claim 15 wherein after washing with a suitable solvent, the intermediate compartment is washed with water.
- 20.(original) The process of claim 15 wherein the intermediate compartment is washed with aniline followed by washing with water.